

NAUI BIO-MARINE EXPLORATION SEMINAR

REPORT ON BIOLOGICAL OBSERVATIONS
OF THE REVILLAGIGEDOS EXPEDITION

APRIL 1974

BY

GORDON L. CHAN

La Paz

Cabo San Lucas

Mazatlan

Islas Marias

COLLEGE OF MARIN

KENTFIELD, CALIFORNIA 94904

U.S.A.

Islas Revillagigedo

Isla San Benedicto

Isla Roca Partida

Isla Socorro

0 100 200
Kilometers

Abstract

The National Association of Underwater Instructors Exploration Seminar to the Revillagigedo Islands in Mexico in April, 1974, revealed two major conclusions about the marine fauna. Observations showed that while the Indo-Pacific fish fauna was present at these islands, the Panamic Pacific Coast tropical fish species were more dominant. Secondly, the molluscan Gastropod fauna was mostly Panamic in speciation.

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1974 NAUI BIO-MARINE EXPLORATION SEMINAR
TO THE REVILLAGIGEDO ISLANDS

I. INTRODUCTION

For many years, divers have longed to visit the volcanic islands of the Revillagigedos (Mexico), situated some 240-270 miles below Cabo San Lucas, the southern tip of the Baja California peninsula. Occasional visitors to the islands reported that the marine life represented a blend of Indo-Pacific and Panamic (Pacific Coast-tropical) marine organisms. Under the sponsorship of the National Association of Underwater Instructors and the Dominican College of San Rafael, an expedition was formed to bring together a group of interested scientists and diving students to investigate this marine habitat April 6-13, 1974. The chief objective was to determine if, indeed, these islands hosted a mixture of Indo-Pacific and Panamic species of marine life.

II. METHODS OF STUDY

A. Sponsoring Agencies

1. Administration

National Association of Underwater Instructors
22809 Barton Road
Grand Terrace (Colton), California 92324

(an organization of some 3,500 diving instructors)

2. Course Accreditation

Dominican College of San Rafael
San Rafael, California 94901

(a fully accredited four-year institution of higher education)

3. Vessel

FINALISTA-100
H & M Landing
Scott & Emerson Streets
San Diego, California 92106

B. Methods of Data Collection

1. Direct observation by scuba diving gear. Our dive master, Robert Justice, listed a total of 275 dives on the trip, with a 15-meter depth as the overall average.
2. Plankton net, 12 mesh.
3. Temperature recorders to measure air and water variations.
4. Salinometer to measure total dissolved solids.
5. Texts and papers on the previous Revillagigedos expeditions.

A lack of research papers, particularly on the corals, prevented a more descriptive speciation listing. None of the species in our listing have, to date, been confirmed by authorities in the particular fauna specialties. In fact, very few of the listed specimens were brought back as collected items. Color photographic slides of the fauna were one of our accomplished goals. Species cited are the results of direct field observations.

III. GENERAL INFORMATION ON THE REVILLAGIGEDO ISLANDS

- A. The Islas Revillagigedo consist of four volcanic islands of this Clipperton Fracture Zone area:

Isla San Benedicto (Figure 4)

A recent volcanic island; last reported eruption was in 1952 (Lewis, Ebeling, 1971). No signs of recent eruptions were observed on our land excursion. The volcano edge is recorded at 920 feet.

Isla Socorro

The largest of the four islands, with the highest peak Cerro Everman at 3,707 feet (Herald, 1971). There is a small Mexican Naval attachment stationed at the southern tip of the island. The commander of the naval forces reported that there had been no rain in this area for 1½ years. The lack of rain was well illustrated by the dry and dusty conditions of both islands.

Isla Roca Partida and Isla Clarion

These smaller islands are located to the west of Isla Socorro and were not visited by our expedition.

- B. Discovery of the Revillagigedos

The discovery of these islands (Richards and Brattstrom, 1959) is credited to the Spaniard Captain Hernando de Grijalva de Villalobos in 1533-1542. Villalobos called the northern island Santa Berto or San Benedicto. A later Spanish visitor, Captain Martin Yanez de Armida, named the island Socorro after his wife (Richard and Brattstrom, 1959).

In 1793, Captain James Colnett of the British Royal Navy

made detailed charts of the islands and named the island group, Revilla Gigedo, in honor of a Spanish count (Richard and Brattstrom, 1959).

Both islands are charted as Pleistocene with Isla San Benedicto having recent volcanism in 1952 (Herald, 1971).

C. Past Expeditions to the Revillagigedos

The major listings of expeditions to these islands are recorded by Richards and Brattstrom, 1959. They list 43 visits, beginning with de Grijalva in 1933. Scripps Institution of Oceanography in La Jolla, California, has made the most institutional visits. In 1971, the California Academy of Sciences made two trips to these islands and established some submarine stations through coordinates. Our expedition revisited four of their scuba stations and the data enclosed in this report simply indicated observations of similar fish fauna. There were many unrecorded visits to these islands by commercial fishing boats, including vessels which collect tropical fish for marine zoos, such as Marine World and Marineland in Southern California. By and large, we observed that large fish life was very abundant and friendly, indicating a lack of human visitors. Contrasting scenes were observed on our dives, of large fish hiding in crevices at Cabo Pulmo Reef near the resort areas of Baja California.

Also, in past expeditions (Kato, 1962, and Herald, 1971) the visitors always remarked that large gray and tiger sharks were very abundant in the waters, even chasing divers out of watery habitats. Much to our pleasant surprise, we saw no sharks on any of our dives at the Revillagigedos.

IV. PRESENTATION OF DATA

A. Participants and Stations

Expedition: NAUI BIO-MARINE EXPLORATION SEMINAR *

College accreditation: Dominican College of San Rafael, Ca.

Date: April 5-13, 1974

Vessel: FINALISTA 100

Ship Captain: Steve Loomis, H. & M. Landing, San Diego

Dive Master: Robert Justice, NAUI Instr. 2596

Expedition Leader & Chief Scientist: Gordon L. Chan, Ph.D., NAUI Instr. 1848

Mexican Scientists: Roberto Calderon Campos

Marine Science Laboratory, Ensenada, Baja Ca., Mex.

Oscar Holguin, Biologist

Institute of National Fisheries, La Paz, Baja Ca.

American Scientists: James Cordy, Naui, Malacologist

Alfonzo Molina, Naui, Marine Biologist-Botanist

Eugene Winter, Naui Instr., Malacologist

Participants:

Douglas Brott, Naui

Bruce Brown, Naui Instr., Fishery

Gordon Fleig, Naui

David Livingston, Naui Instr, Photography

Edward Major, M.D., Naui Instr.

Irene Major, YMCA Instr.

Nan Nutt, Naui Instr.

Catherine O'Leary, Naui

Mary Ellen Over, Naui Instr., Ecology

Edwin Pier, Naui, Oceanographic Scribe

Philip Rupel, Naui Instr., Photography

Ralph Stogsdall, Naui Instr., Ecology

Sylvia Sund, Naui

Marvin Tincher, Naui

David Toponce, Naui, Photography

Tet Uno, Naui, Malacology

NAUI Sample Stations (Sta.)

1. La Paz Harbor
2. Isla Cerralvo, Roca Montana
3. Plankton, Pacific Ocean, SW Cabo San Lucas
4. Plankton, NE of Isla San Benedicto
5. Isla San Benedicto, Punta Ortolan
6. Isla San Benedicto, Lava Delta; Volcano Barcena
7. Isla San Benedicto, Punta Ortolan
8. Isla Socorro, Ensenada Grayson
9. Isla Socorro, Bahia Braithwaite
10. Plankton, off Punta Palmilla, Baja California
11. Pinnacle de Los Frailes
12. Cabo Pulmo Coral Reefs

* National Association of Underwater Instructors, Colton, Calif.

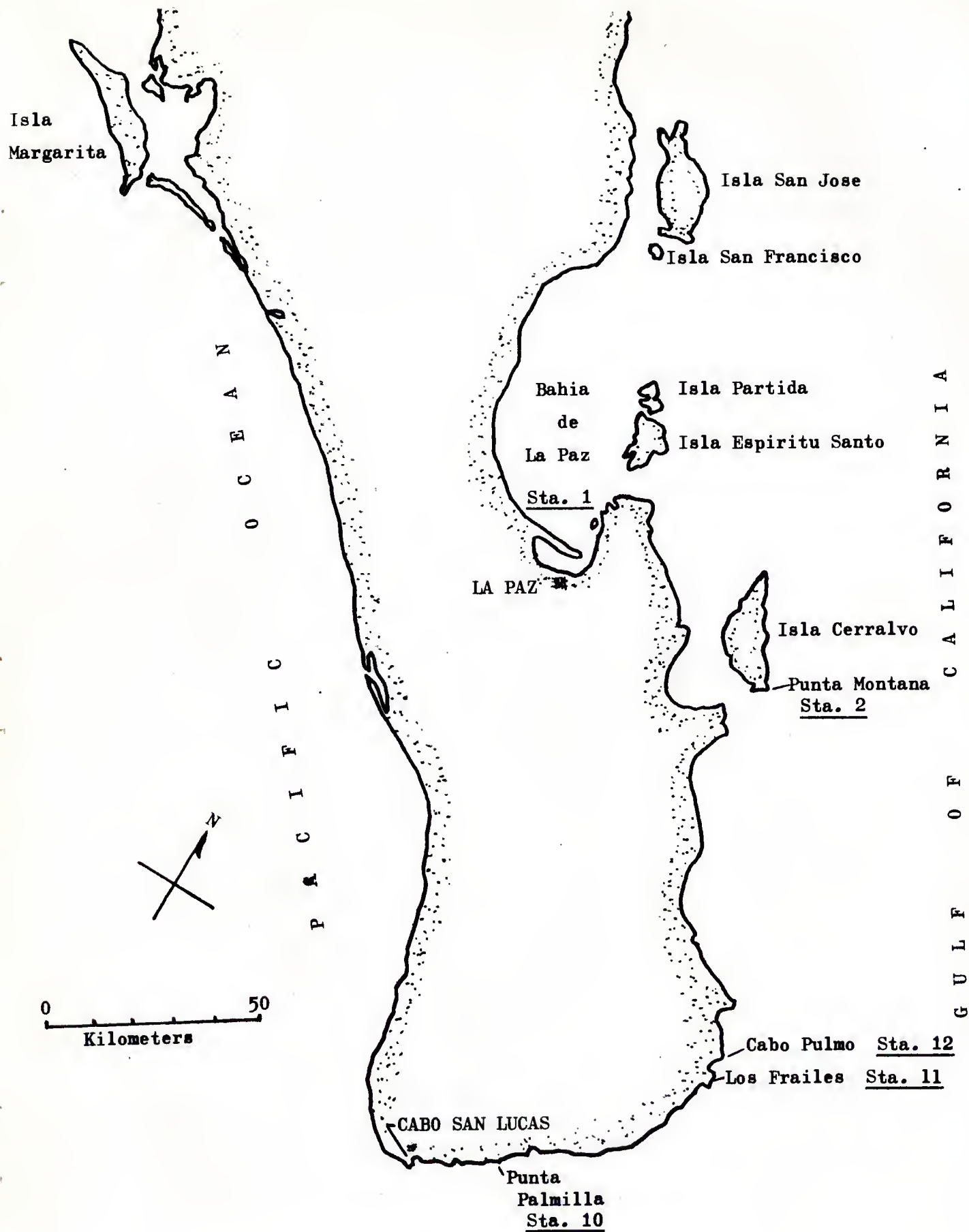


FIG 1. SOUTHERN PENINSULA OF BAJA CALIFORNIA.

STATION LOG

NAUI Sample Station: No. 1 - La Paz Harbor (Figure 1)Date: April 5-7 and 13, 1974Lat. 24°9' N Long. 110°20' WStation Event: plankton, scubaChief Scientist: ChanAir temperature: 30°CWeather: clearSurface Water temp: 24°CWind: 2-4 mph Sea swell 0Bottom Water temp: 19°CSalinity (TDS): 38 ‰Water visibility: 4.6 m (est.)Bottom topography: sandTotal No. of dives: 5 Depth range: 4.6m to 7.6m Avg. depth 6.1mMAJOR EVENTS/ ORGANISMS OBSERVEDMolluscaPlanktonPelecypoda

mostly Copepods

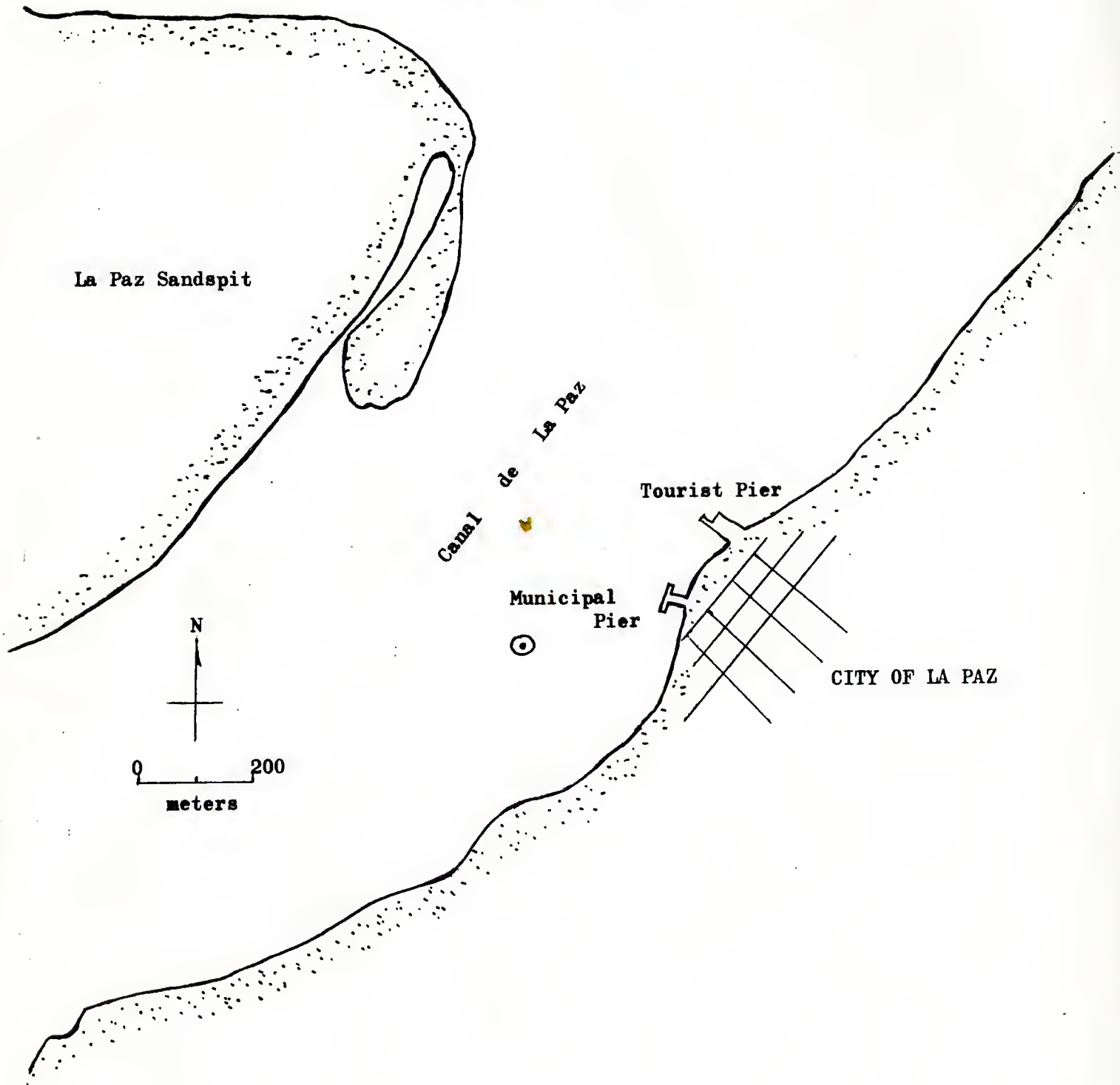
Pecten aequisulcatus, PectenGastropoda*Cerithium* sp., Hornshell*Oliva spicata*, Olive shell*Hexaplex erythostomus*, Pink murex*Terebra* sp., AugerErrata - Revillagigedo

6/74

Forcipiger flavissimus instead of F. longirostrisDiodon holocanthus instead of D. histrixEpinephelus (Dermatolepis) dermatolepis instead of D. inermis

(G U L F O F C A L I F O R N I A)

B a h i a d e L a P a z



F i g 2. HARBOR OF LA PAZ

STATION LOG

NAUI Sample Station: No. 2 - Isla Cerralvo, Roca Montana (Figure 2)

Date: April 7, 1974; 1430 hr.

Lat. 24° 8' N Long. 110° 47' 30" W

Station Event: Scuba

Chief Scientist: Chan

Air temperature: 27°C

Weather: Clear

Surface Water temp: 24°C

Wind: 1-3 mph Sea swell 1 ft

Bottom Water temp: 18°C

Salinity (TDS): 38 ‰

Water visibility: 18.2 m (est.)

Bottom topography: Volcanic boulders covered with coral; crevices with sand and old shells

Total No. of dives: 40 Depth range: 10.7m to 18.3m Avg. depth 16.4m

MAJOR EVENTS/ ORGANISMS OBSERVED

Ship, FINALISTA 100, anchored over the reef, depth of 10.7 meters. Sandy crevices between large volcanic rocks. Many coral heads, *Pocillopora* spp., about 0.5 to 0.8 meters wide, extending up about 0.5 meters. Outstanding event: observed the Crown of Thorns starfish *Acanthaster planci* feeding on *Pocillopora* spp. Many of the coral heads were dead, a bright white color. The density of the Crown of Thorns starfish here was the highest ever seen in the Gulf of California region by the divers present, estimated to have observed one starfish every 10 square meters.

Marine algae was quite abundant, types resembling the Pacific Coast species of *Callophyllis* sp., *Codium* sp., and *Cladophora* spp.

Major Phyla

Porifera

Terpiaz sp., sponge

Coelenterata

Aglaophenia sp. abundant growth of these stinging hydroids

Alcyonaria Gorgonians were extremely abundant

Muricea californica

Gorgonia spp.

Gorgonia adamsi

Eugorgia spp.

Zoantharia

Tubastraea tenuilamellosa, yellow coral

Pocillopora capitata many coral heads, dead (white), older dead coral were covered with algae

Platyhelminthes (flatworms)

Pseudoceros sp.

Annelida (polychaete)

Sabellidae type - four species
Serpulidae

Mollusca

Pelecypoda (many broken shell fragments covered the sandy crevices)

Lyropecten subnodosus, Pecten

Gastropoda

Cypraea albuginosa, Cowry
Strombus galeatus, Conch
Fasciolaria princeps, Spindle
Conus diadema, Cone

Opisthobranchiata (nudibranchs)

Tridachiella diomedea (common)
Polycera sp.

Arthropoda

Balanus tintinnabulum (common barnacle)
Panulirus inflatus, Lobster
Stenorhynchus sp., Arrow crab, similar to Hawaiian species, in coral heads

Bryozoa

Membranipora spp.

Echinodermata

Asteroidea (Starfish)

Pharia pyramidata, Granulated starfish
Phatiria unifascialis, Pored starfish
Linckia sp.
Acanthaster planci, Crown of Thorns, about 1/10 m.²

Ophuroidea

Ophioderma sp., Brittle star

Echinoidea

Eucidaris thouarsii, Club urchin
Diadema mexicanum, Black urchin

Holothuroidea

Isotichopus fuscus, Sea cucumber

Chordata

Osteichthyes (the water was dense with many young unidentified fish)

Sphyrna sp., Hammerhead shark
Dasyatis sp., Stingray
Rhinobatos sp., Shovelnose guitarfish
Harengula thrissina, Herring
Cirrhitidae sp., Hawkfish
Mycteroperca rosacea, Leopard wrasse
Epinephelus analogus, Grouper
Diodon sp., Porcupine fish
Seriola dorsalis, Yellowtail
Lutjanus sp., Pargo snapper
Halichoeres sp., Wrasse
Mulloidichthys sp., Goatfish
Thalassoma lucasanum, Wrasse
Lythyrulon flaviguttatum, Cortez Grunt
Pomacanthus sp., Angel
Holocanthus sp., Angel
Balistes sp., Triggerfish
Pomacentrus spp., Damselfish
Chromis atrilobata, Damselfish
Abudefduf sp., Sargent-major
Heniochus nigrirrostris, Butterfly
Gnathanodon sp., Jack
Caranx marginatus, Toros
Blenniidae spp., Blenny
Gobiidae, Goby
Gymnothorax castaneus, Moray

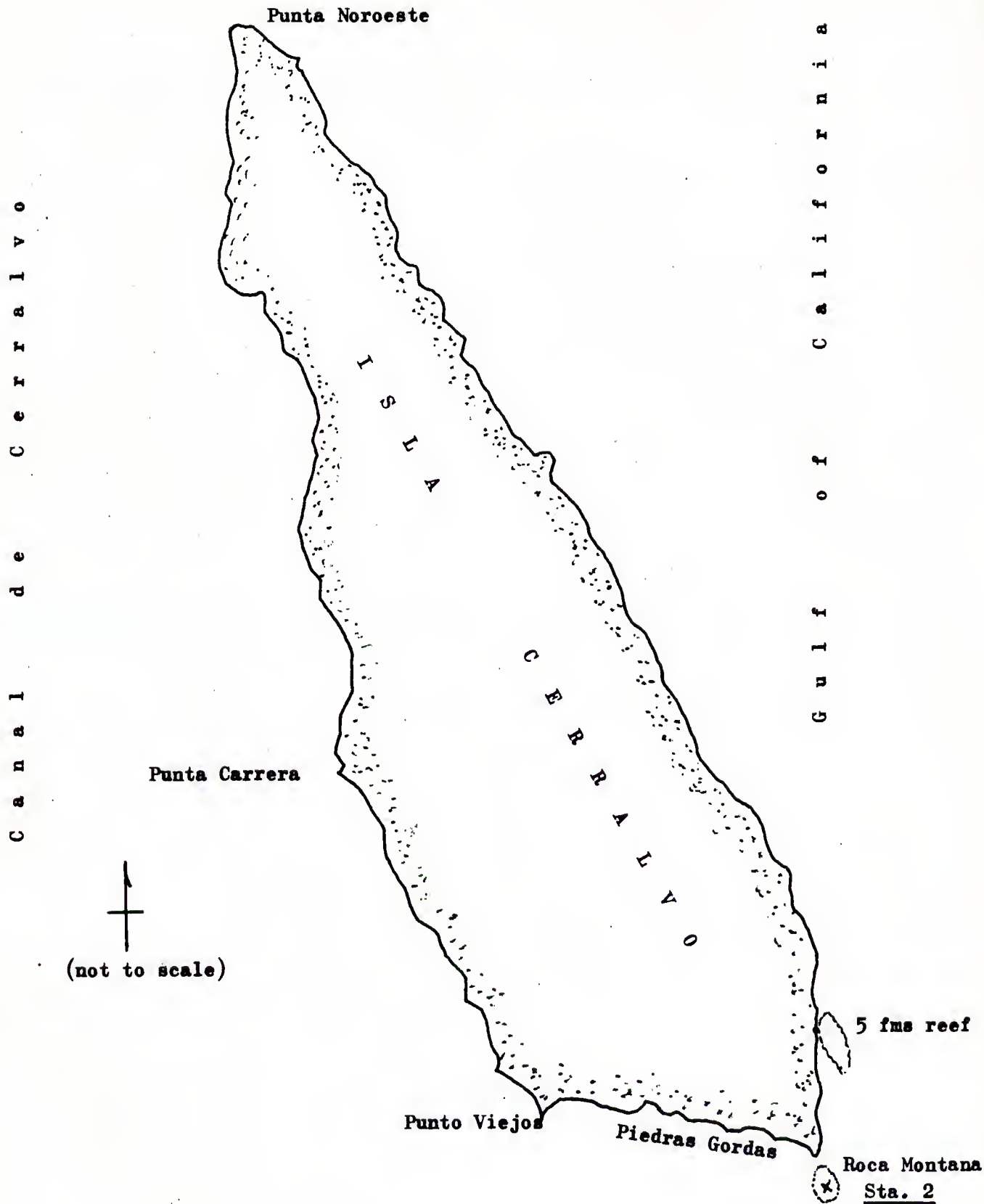


Fig 3. ISLA CERRALVO, ROCA MONTANA

STATION LOG

NAUI Sample Station: No. 3 - Pacific Ocean, 70 miles S.W. of Cabo San LucasDate: April 8, 1974; 1000 hr.Lat. 21° 45' N Long. 110° 5' WStation Event: PlanktonChief Scientist: MolinaAir temperature: 27°CWeather: ClearSurface Water temp: 21°CWind: 4-7 mph Sea swell 3-5 ftBottom Water temp: --Salinity (TDS): 36 ‰Water visibility: -- (est.)Bottom topography: --Total No. of dives: Depth range: to Avg. depth MAJOR EVENTS/ ORGANISMS OBSERVEDPlankton - surface tow

Ceratum

Radiolarians

Copepods

Pteropods

young fish

STATION LOG

NAUI Sample Station: No. 4 - 56 miles N.E. Revillagigedos

Date: April 8, 1974

Lat. 19° 45' N Long. 110° 40' W

Station Event: Plankton

Chief Scientist: Molina

Air temperature: 26°C

Weather: Clear

Surface Water temp: 22°C

Wind: 6-11 mph Sea swell 3-5 ft

Bottom Water temp: _____

Salinity (TDS): 36.5 o/oo

Water visibility: _____ (est.)

Bottom topography: _____

Total No. of dives: _____ Depth range: _____ to _____ Avg. depth _____

MAJOR EVENTS/ ORGANISMS OBSERVED

Plankton - surface tow

mostly Copepods

Ceratium

Chaetognaths

STATION LOG

NAUI Sample Station: No. 5 and 7 - Isla San Benedicto, Punta Ortolan (Figure 4)

Date: April 9, 1974

Lat. 10°19'05" N Long. 110°48'15" W

Station Event: Scuba

Chief Scientist: Chan

Air temperature: 22°C

Weather: Clear

Surface Water temp: 22°C

Wind: 12-19 mph Sea swell 3-5 ft.

Bottom Water temp: 19°C

Salinity (TDS): 36 ‰

Water visibility: 15.2 m. (est.)

Bottom topography: Basaltic crevices, covered with coral heads

Total No. of dives: 68 Depth range: 7.7m to 22.9m Avg. depth 15.5m

MAJOR EVENTS/ ORGANISMS OBSERVED

The cove, south of Punta Ortolan, Figure 4, was the outstanding dive spot in our Revillagigedos experience. Large coral heads, *Porites* sp., up to 1.5 meters, ranging from 9 to 3 meters of the surface were magnificantly profuse with fish life. In some areas, the *Porites* coral growth covered the vertical and horizontal rocks for about 10 square meters.

Outstanding observations:

1. Three Hawaiian species of fish (very common in Hawaii) were numerous amongst these coral reefs: *Zanclus canescens*, the Moorish idol; *Acanthurus achilles*, surgeonfish; *Forcipiger longirostris*, Long-nose butterfly fish.

The endemic Golden Angel fish, *Holocanthus clarionensis*, was also common, and all participants agreed that it was a most beautiful fish to photograph.

Most of the fish life, however, is more directly related to Panamic fauna.

2. Crown of Thorns, *Acanthaster planci*, was also observed, but density not as numerous as at Isla Cerralvo.
3. Molluscan gastropods were similar to those found in Mexican Panamic waters (after Keen).

Phyla

Porifera

encrusting purple sponge

Coelenterata

Aglaophenia sp.

Yellow Gorgonia (numerous)

Scleractina, hard corals

Porites sp.
Pocillopora sp.
Pavona sp.
Two other unknown coral species

Annelida

Encrusting sabellid worm with yellow tentacles
Hermodice sp., Fireworm, under rocks and old coral heads

Mollusca

Pelecypoda

Ostrea palmula, Oyster

Gastropoda

Casmaria vibexmexicana, Helmet
Cypraea albuginosa, Cowry
C. isabellamexicana, Cowry
Thais planospira, Thais
Latirus socorroensis, Spindle (endemic)
Conus diadema, Cones
C. tiaratus
C. dalli
C. nux
C. purpurascens

Echinodermata

Asteroidea

Nidorellia armata, the armed starfish, found in the Gulf of California
Acanthaster planci, Crown of Thorns

Echinoidea

Heterocentrotus mammillatus, Slate urchin, also found in Hawaii
Eucidaris thouarsii, Club urchin found in the Gulf of California
Diadema sp., Black urchin

Chordata (fish)

Manta birostris, large Manta rays, width up to 4 meters
Caraux sp., Black spot jack
Mulloidichthys sp., Goatfish
Pomacentrus sp., Damsel
Thalassoma spp., Butterfly
Acanthurus achilles, Surgeonfish, common in Hawaii
Chromis sp., Chromid
Cirrhitops sp., Hawkfish
Forcipiger longirostris, long-nose Butterfly fish, common in Hawaii
Zanclus canescens, the Moorish idol, common in Hawaii
Holocanthus clarionensis, the Golden Angel of the Revillagigedos
Ophiblernius steindachneri, the giant blenny, very common, hiding in the coral heads
Diodon histrix, Porcupine fish

Thalassoma spp., Wrasse
Paralabrax sp., Grouper
Gymnothorax sp., Green Moray
Gymnothorax sp., Spotted Moray

Sta. 4
Plankton Samp.

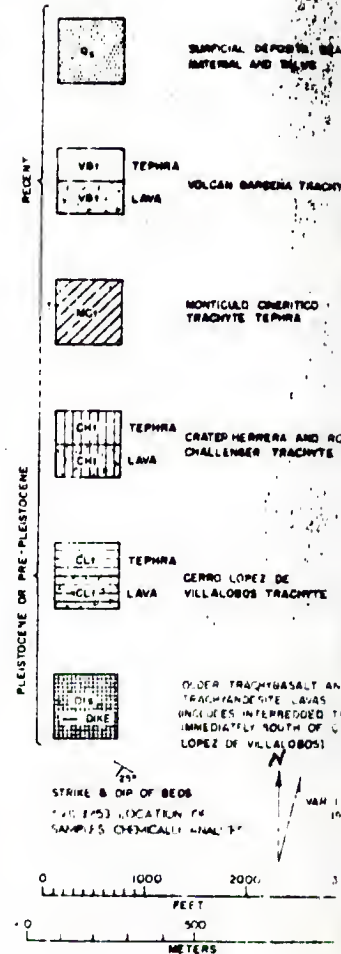
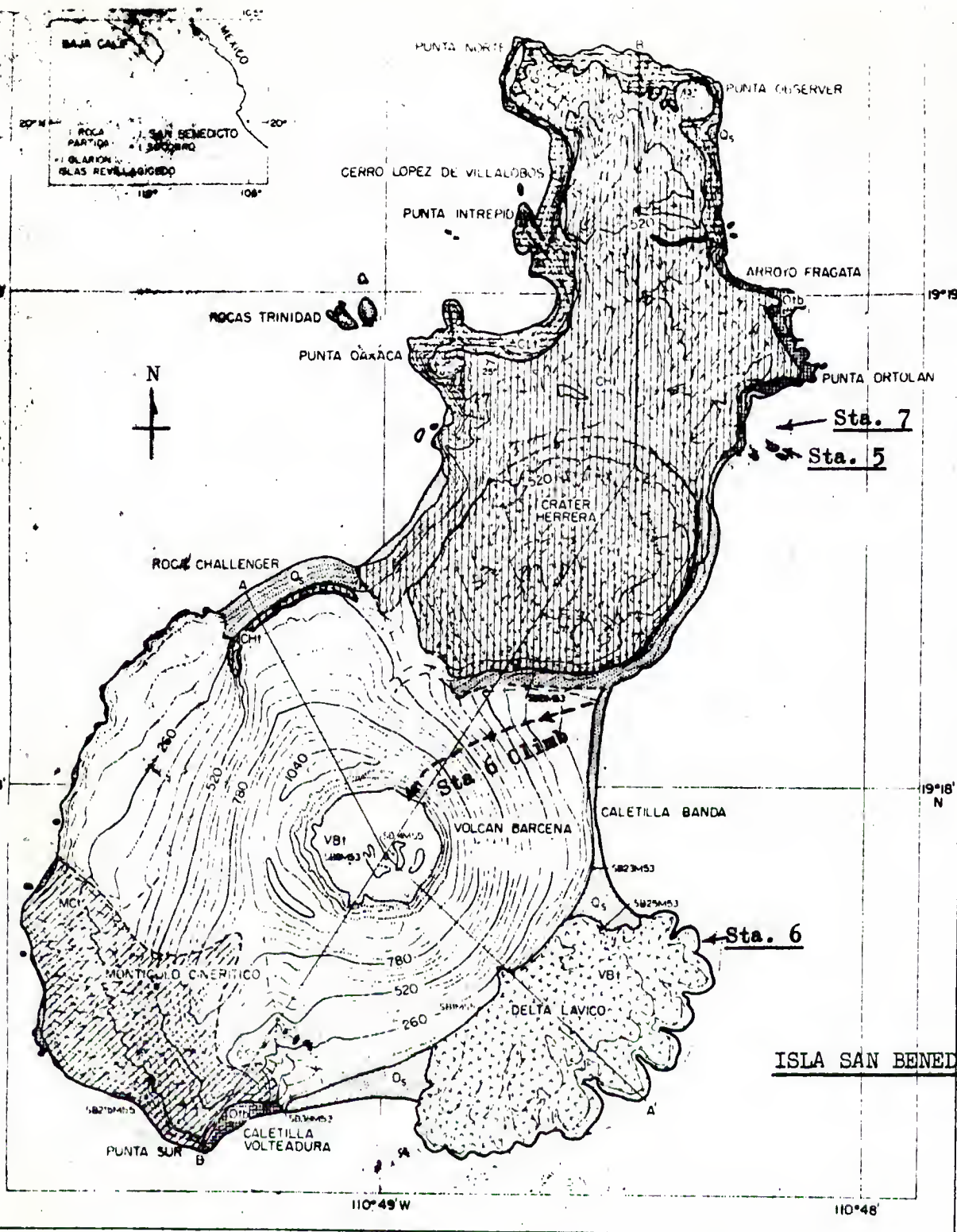


Fig. 4. Revillagigedo Islands, ISLA SAN BENEDICTO (Herald, 1971)

STATION LOG

NAUI Sample Station: No. 6 - Revillagigedos, Isla San Benedicto Lava Flow (Figure 4)

Date: April 9, 1974

Lat. 19° 18' 09" N Long. 110° 49' 15"W

Station Event: Scuba

Chief Scientist: Chan

Air temperature: 27°C.

Weather: Clear

Surface Water temp: 23°C.

Wind: 6-11 mph Sea swell 1-3 ft

Bottom Water temp: 20°C.

Salinity (TDS): 36.5 ‰

Water visibility: 9.1m (est.)

Bottom topography: Rocky Basaltic boulders

Total No. of dives: 4 Depth range: 3 m to 9.1m Avg. depth 4.6 m

MAJOR EVENTS/ ORGANISMS OBSERVED

Two teams of divers led by Dr. Eugene Winters investigated the submarine toe of the lava delta, Figure 4, and reported extensive growths of coral heads, mostly *Porites* sp., ranging from 0.4 to 1 meter in height. The coral growth ranged from depth of 6.1 to 3 meters.

Marine biologist Al Molina led a group of students to the Caletilla Beach, Figure 4. An eight-foot surf made landing extremely difficult; two cameras were lost in the swim to the beach.

The climb up to the top of the Volcano Barcena, about 1,000 feet, was very dusty. The wind gusted up to 30 mph. The blowing dust, swirling about the volcano, made it appear to be erupting. These observations were recorded:

1. The view of the volcano was outstanding.
2. No plants were observed on the volcanic slopes--far too dusty for roots to take hold.
3. There were burrow nests of the Brown Booby, *Sula leucogaster*, on the edge or lip of the volcano Barcena. On eyoung Booby was observed in a nest.

Climbers all remarked that this volcano is a magnificent sight.

STATION LOG

NAUI Sample Station: No. 8 - Isla Socorro, Ensenada Grayson (Figure 5)

Date: April 10, 1974

Lat. 18° 44' 18" N Long. 111° 20' W

Station Event: Scuba

Chief Scientist: Chan

Air temperature: 26° C.

Weather: Clear

Surface Water temp: 22° C.

Wind: 3-4 mph Sea swell 2-4 ft

Bottom Water temp: 19° C.

Salinity (TDS): 36 ‰

Water visibility: 18.3m (est.)

Bottom topography: Large basalt boulders near shore, small coral heads, sand bottoms

Total No. of dives: 28 Depth range: 9.1m to 27.4m Avg. depth 18.3m

MAJOR EVENTS/ ORGANISMS OBSERVED

The scuba dives covered the sandy beaches of Ensenada Grayson to the Double Pinnacles rocks, Figure 5, at the north part of the cove. *Porites* sp. coral heads were small, 0.2 to 0.5 meters, ranging from 1-8 meters in water depth.

Outstanding event was the discovery of the three endemic shells (Keen, 1971) of the Revillagigedos Islands. They were:

Turbo funiculosus, *Columbella socorroensis*, and *Latirus socorroensis*

As at Isla San Benedicto, the uncommon cowry, *Cypraea isabellamexicana*, was discovered, with one specimen reaching a large size of 3.9 cm. Found on the Mexican coast, this may be the first time that *C. isabellamexicana* has been reported on the Revillagigedos Islands.

Large octopi were common in rocky crevices, up to 1 meter arm span.

Major species observed

Algae

A sargassum-like algae, rising about 25 cm. on the subtidal rocks was very common. A species of *Macrocystis* sp. was also observed, attached to rocks in Ensenada Grayson rocky shores.

Coelenterata

Small Gorgonians were common at depths of 7 meters at Double Pinnacles rocks.

Porites sp. coral heads were small, certainly not as lush in growth as at Punta Ortolan, Isla San Benedicto.

Tubastraea sp. was also observed, probably the same species as *T. tenuilamellosa* in the Gulf of California

An unidentified red anemone was common at depths of 5 meters.

Annelida

Polychaeta calcium tubes, yellow tentacles

Mollusca *endemic species (Keen, 1971)

*Turbo funiculosus**, Turbo snail
*Columbella socorroensis**, Dove shell
*Latirus socorroensis**, Spindle shell
Cypraea isabellamexicana, Cowry
Conus diadema, Cone
C. tiaratus, Cone
Siphonaria spp., Limpet

Large octopi were common in the rocky crevices; some had arm-spans up to one meter.

Arthropoda

Plankton tow at night, April 10, revealed hundreds of small isopods, about 5 mm. in length.

Hermit crabs with orange chela were common in empty shells.

Paniluris inflatus, Lobster, common in rocky crevices

Echinodermata

Holothuroidea - two species

Asteroidea

Acanthaster planci, Crown of Thorns, small sizes, up to 24 cm. for the arm spans.

Pisaster sp. -like asteroids at Double Pinnacles rocks

Echinoidea

Diadema sp., Black urchin

Heterocentrotus mammillatus, Slate urchin

Eucidaris thousarsii, Club urchin

Chordata (fish)

Dermatolepis punctatus, Leather Bass

Epinephalus spp., Spotted Grouper

Priacanthus cruentatus, Big-eye

Holocanthus clarionensis, Clarion Golden Angel

Forcipiger longirostris, Longnose Butterfly

Heniochus nigrirostris, Blacknose Butterfly

Cirrhitus rivulatus, Hawkfish

Myripristis sp., Squirrel fish

Diodon hystrix, Porcupine fish

many Damselfish

Acanthurus spp., Surgeon fish

Prionurus punctatus, Yellowtail tang

Ophiblenius steindachneri, Giant blenny

Thalasoma spp., Wrasse
Zanclus canescens, Moorish Idol
Aulostomus sp., Trumpet fish
Gymnothorax sp., Moray
Manta birostris, Manta

ISLAS REVILLA GIGEDO

ISLA SOCORRO

Sketch survey by U.S.S. Narragansett 1874

Scale 1:145,900

VAR 10° 15' E (1965)

ANNUAL DECREASE 2'

Chart 1688

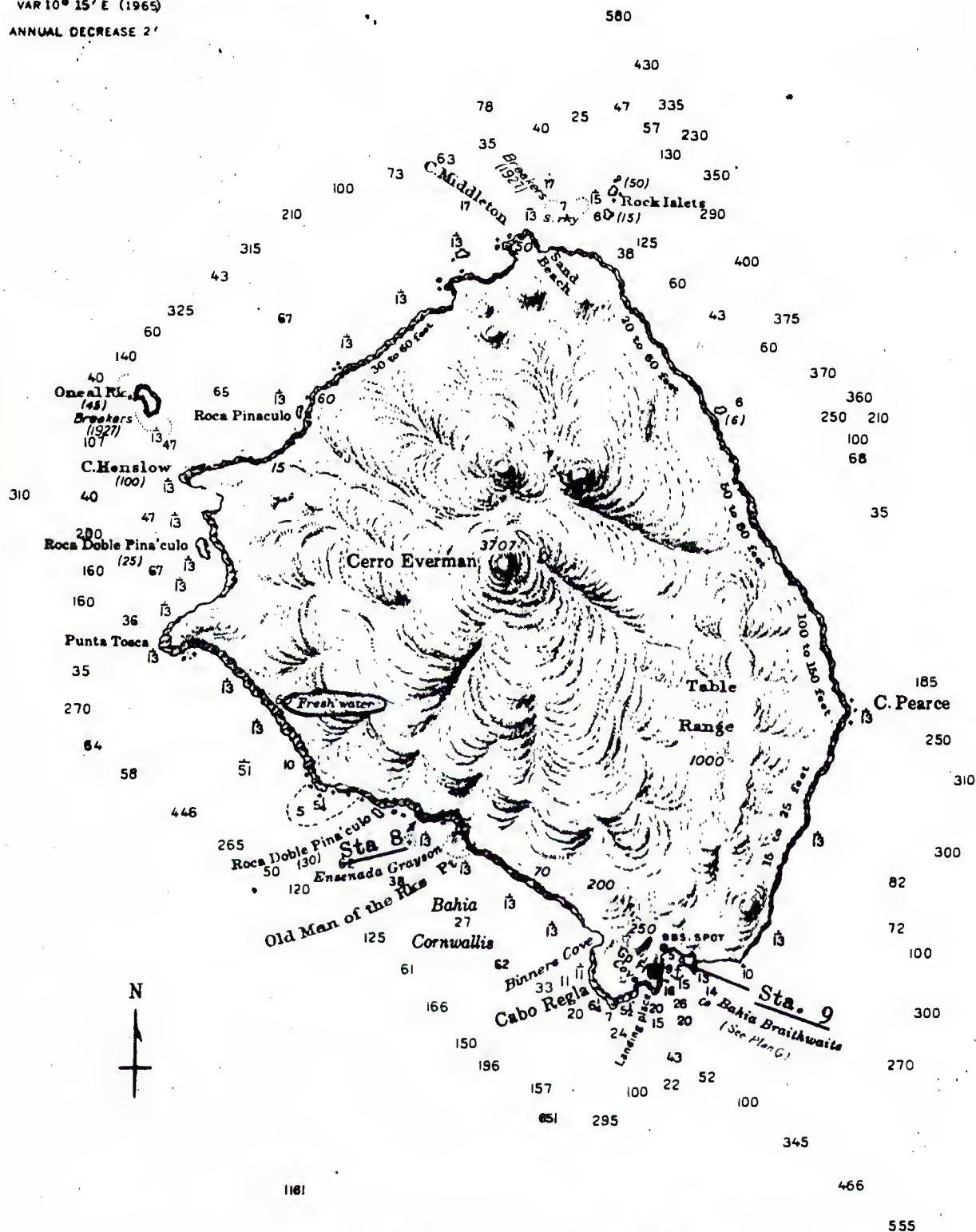
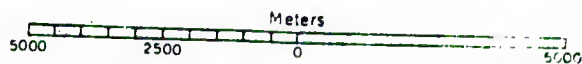
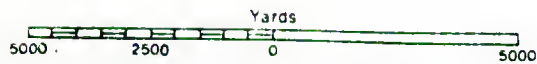


Fig. 5. ISLA SOCORRO (Herald, 1971)



STATION LOG

NAUI Sample Station: No. 9 - Isla Socorro, Bahia Braithwaite, Iguana Rock

Date: April 10, 1974; 1730 hr.

Lat. 18° 43' 25" N Long. 111° 57' 20" W

Station Event: Scuba (+ land excursion)

Chief Scientist: Chan

Air temperature: 23°C.

Weather: Clear

Surface Water temp: 23°C.

Wind: 3-7 mph Sea swell 1-3 ft

Bottom Water temp: 19°C.

Salinity (TDS): 36 ‰

Water visibility: 18.1m (est.)

Bottom topography: Large basaltic rocks near shore, sand bottoms at deeper depths

Total No. of dives: 36 Depth range: 3 m to 22.9 m Avg. depth 14.3 m

MAJOR EVENTS/ ORGANISMS OBSERVED

Anchorage southwest of the naval station, Figure 5, near a rock which resembled an iguana. Coral, *Porites* sp., was limited to the near shore rocks, in 2 to 4 meters of water depth.

Outstanding event: At Ensenada Grayson, the large rocks sheltered many octopi, with arm spans ranging up to 1 meter. The three endemic gastropods which were found at Ensenada Grayson were also found here. A species of triton, identified by Jim Cordy as *Cymatium pileare*, with a very hairy periostracum, was found, and this shell is reported as Indo-Pacific (Keen, 1971).

Major Phyla

Porifera

Purple sponge - encrusting

Coelenterata

small Gorgonians

Porites sp., Coral -- growth was sparse and small in size as compared

Pavona sp., Coral to coral at Isla San Benedicto, Punta Ortolan.

Annelida

Polychaete -- Sabellid, calcium test, double tentacles

Mollusca

Chiton - unidentified

*Turbo funiculosus**, Turbo

Cassis Coarctata, Helmet shell

Cymatium pileare, Hairy triton

Purpura pausa, Thais

Cerithium maculosum, Horn

*Columbella socorroensis**, Dove

*Latirus socorroensis**, Spindle

Thais planospira, Thais

Mitra tristis, Miter
Terebra strigata, Auger
Comus diadema, Cone
C. purpurascens, Cone
Siphonaria spp., Limpet
Octopus spp.

Arthropoda

Panilurus inflatus, Spiny lobster
Hermit crabs, assorted species
other types of Rock crabs and Shore crabs, unidentified

Echinodermata

Acanthaster planci, Crown of Thorns, up to 25 cm.
Sea Urchins -- common
Diadema sp.--very abundant, at night they covered the rocky surfaces
with their long spines.

STATION LOG

NAUI Sample Station: No. 10 - South of Punta Palmilla, Figure 1

Date: April 12, 1974; 0845 hr.

Lat. 22° 57' N Long. 109° 40' W

Station Event: Plankton

Chief Scientist: Chan, Molina

Air temperature: 24°C.

Weather: Clear

Surface Water temp: 18°C.

Wind: 3-5 mph **Sea swell** 1-3 ft

Bottom Water temp: _____

Salinity (TDS): 34 ‰

Water visibility: _____ (est.)

Bottom topography: _____

Total No. of dives: _____ Depth range: _____ to _____ Avg. depth _____

MAJOR EVENTS/ ORGANISMS OBSERVED

Major Plankton

Surf waters were a reddish color. Plankton sample revealed that the coloration was caused by a dense bloom of a megalop crab, *Pleuroncodes* sp.(?). Also gathered was a group of a rare pelagic Heteropoda, *Carinaria* sp. This species is an elongated transparent molluscan, 2.5 cm. in length.

About 10 minutes later, in the same general area of Punta Palmilla, a large swordfish, *Xiphias gladius*, 3.15 meters in length, was hauled aboard the FINALISTA 100. Two rare zebra-colored barnacles, *Cryptoconchus* sp., were found embedded in the flesh of the fish.

STATION LOG

NAUI Sample Station: No. 11 - Pinnacle de Los Frailes, Figure 6

Date: April 12, 1974; 1500 hr

Lat. 23° 24' N Long. 104° 25' W

Station Event: Scuba

Chief Scientist: Chan

Air temperature: 26°C.

Weather: Clear

Surface Water temp: 21°C.

Wind: 1-3 mph Sea swell 2-4 ft

Bottom Water temp: 19°C.

Salinity (TDS): 36 ‰

Water visibility: 9.1 m. (est.)

Bottom topography: Granitic rocks surrounded by sandy bottom

Total No. of dives: 41 Depth range: 9.1 m to 21.3 m Avg. depth 15.2

MAJOR EVENTS/ ORGANISMS OBSERVED

The rocky pinnacle emerges just north of Punta Los Frailes, Figure 6, and is surrounded by a sandy bottom, approximately 21.3 meters in depth. The garden eels, *Taeniconger* sp. (Hobson, 1968), were quite numerous at the 21-meter depth, but they did not appear to me to be as large as specimens found at Isla Partida, near La Paz, Baja California.

Outstanding event was the observation of the longnose butterfly fish, *Forcipiger longirostris*. This Indo-Pacific fish is common at the big island of Hawaii and was observed at Isla San Benedicto. Now for the first time in my experience in the Gulf of California, this fish is observed here at Los Frailes. The influence of Indo-Pacific fish fauna seems to be more prevalent now along the Eastern Pacific Ocean waters.

Major phyla

Porifera

many blue-vased sponges

Coelenterata

Gorgonians were common

Psammogorgia sp.

Muricea californica

Gorgonia adamsi

Gorgonia sp.

Eugorgia spp.

Corals

Porites spp.

Pocillopora sp.

Pavona sp.

Some of the *Porites* sp. coral heads ranged up to 1.3 meters in width, rising up to 0.7 meters in height from the granite rocks.

Annelida

Eurythoe sp., Polychaete with stinging setae

Mollusca

Opisthobranchia (sea slugs)

Aplysia sp.
Hypselodoris californiensis
Polycera sp.
Tridachiella diomedea

Gastropoda

Strombus galeatus
Corus diadema

Arthropoda

Panilurus inflatus, Spiny lobster
Stenorhynchus sp., Arrow Crabs in coral heads

Echinodermata

Asteroids

Phataria unifascialis
Astrometis sertulifera
Ophiocoma sp.

Echinoidea

Eucidaris thousarsii, Club urchin, very common in crevices
Diadema mexicanum, Black urchin
Lovenia cordiformis, Heart urchin in sands
Encope californica, Sand dollar in sand

Holothuroidea

Isostichopus sp., Sea cucumber

Chordata (fish)

Dasyatis sp., Stingray
Cirrhitidae sp., Hawkfish
Mycteroperca rosacea, Leopard Cabrilla
Epinephelus analogus, Grouper
Diodon histrix, Porcupine fish
Halichoeres sp., Wrasse
Thalassoma lucasanum, Wrasse
Forcipiger longirostris, Longnose Butterfly fish
Heniochus nigriristris, Blacknose Butterfly fish
Pomacanthus sp., Angel fish
Holocanthus sp., Angel fish

Chromis sp., Damsels
Lythruion flaviguttatum, Grunt
Blenniidae (spp.)
Gobiidae (spp.)
Gymnotichthys castaneus, Moray

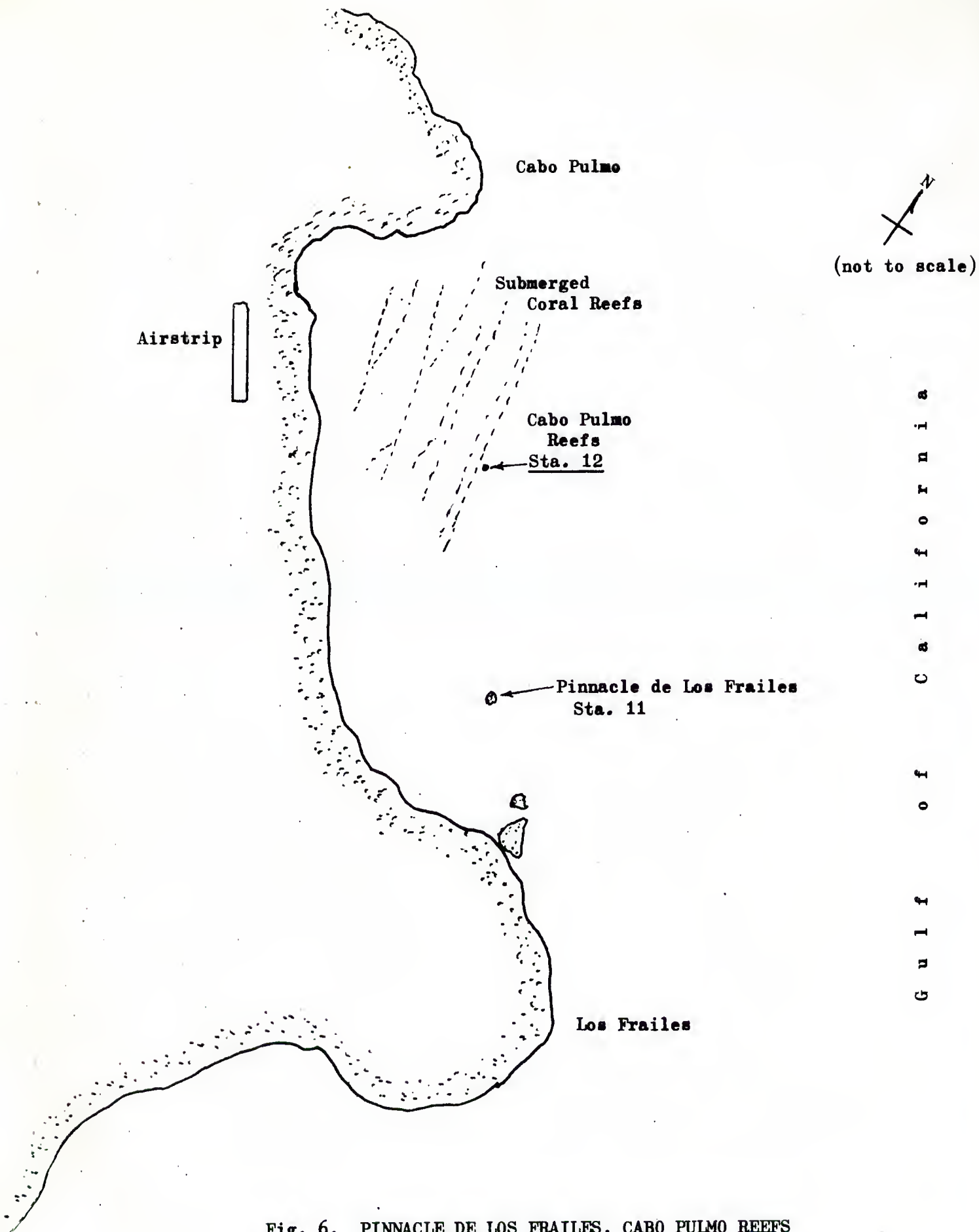


Fig. 6. PINNACLE DE LOS FRAILES, CABO PULMO REEFS

STATION LOG

NAUI Sample Station: No. 12 - Cabo Pulmo Reef, Figure 6

Date: April 12, 1974; 1630 hr.

Lat. 23° 25' 15" N Long. 109° 24' 30" W

Station Event: Scuba (day and night)

Chief Scientist: Chan

Air temperature: 27°C.

Weather: Clear

Surface Water temp: 21°C.

Wind: 1-3 mph Sea swell 2-4 ft

Bottom Water temp: 20°C.

Salinity (TDS): 38 ‰

Water visibility: 12.2m (est.)

Bottom topography: Elongated ridges of basaltic rock, with coral heads, sandy bottom

Total No. of dives: 53 Depth range: 6.1 m to 15.2 m Avg. depth 10.7 m
(includes night dives)

MAJOR EVENTS/ ORGANISMS OBSERVED

Elongated shallow reefs, at about 9.1 meter depth, are scattered throughout the area south of Cabo Pulmo. Our station covered the outermost reef, about 3 kilometers north of Pinnacle de Los Frailes, Figure 6. Essentially the organisms in both areas are similar.

Large coral heads were found rising from these reefs, up to 2 meters wide and up to 0.8 meter high. *Porites* sp. and *Pocillopora* sp. were the dominant species. Many of the coral heads were fragmented, a sign of either storm activities or anchor damages. The Crown of Thorns, *Acanthaster planci*, was observed on these corals, though not as common as at Roca Montana, Isla Cerralvo.

A night dive revealed that the paper sea cucumber, *Euapta* (Opheodesoma) *godeffroyi*, was very common throughout the reefs. *Aplysia* sp., a large tectibranch, was common in the sand flats. Jim Cordy found an uncommon shell, *Conus tessalatus* (Keen, 1971).

We also observed that the groupers, parrot fish, and other larger fish were hiding in crevices during the daytime, unlike the friendliness of these similar species at the Revillagigedos Islands. Perhaps man's presence as a visitor is more frequent to these Cabo Pulmo reefs.

Major phyla

Coelenterata

Gorgonians were common, as at Los Frailes Pinnacle

Platyhelminthes

Pseudoceros mexicanus, a swimming flatworm, common over the sand flats at night

Nemertea

Baseodiscus sp., a striped nemertean worm was common on the rock reefs at night

Arthropoda

Dardanus sp., Hermit crabs
Panilurus inflatus, Spiny lobster

Mollusca

Opisthobranchia

Aplysia sp., Sea slug, common over sand at night

Pelecypoda

Pecten subnodosus, Pecten
P. vogdesi, Pecten
P. circularis, Pecten

Gastropoda

Strombus galeatus, Conch
Conus deadema, Cone
C. dalli
C. tessulatus
Cassis coarctata, Helmet
Murex princeps, common murex
Fasciolaria princeps
Oliva porphyria, dead tent olive
O. incrassata, Olive
Terebra sp., Horn shell

Echinodermata

Asteroids

Acanthaster planci, Crown of Thorns, up to 25 cm. for arm span
Phataria unifascialis
Astrometis sertulifera

Echinoidea

Eucidaris thousarii
Diadema mexicanum

Holothroidea

Euopta (Opheodesoma) *godeffroyi*, paper sea cucumber

Chordata (fish)

Dasyatis sp., Stingray
Pomacentrus spp., Damsels
Chromis sp., Damsels
Heniochus nigrirostris, Butterfly fish
Lutjanus sp., Snapper in crevices
Epinephelus analogus, Grouper in crevices

Diodon histrix, common Porcupine fish
Thalassoma sp., Wrasse
Pomacanthus sp., Angel
Holocanthus sp., Angel
Gymnothorax castaneus, Moray

B. Mollusca Data

1. Mollusca Species List (after Keen, 1971)

37 species

common name

Class: <u>Amphineura</u> , species unknown	chiton
Class: <u>Pelecypoda</u>	
Family: <u>Ostreidae</u>	
<i>Ostrea palmula</i> Carpenter, 1857	rock oyster
<u>Pectinidae</u>	
<i>Argopecten circularis</i> (Sowerby, 1835)	scallop
<i>Pecten aequisulcatus</i> (Carpenter, 1864)	scallop
<i>P. vogdesi</i> Arnold, 1906	scallop
<i>Lyropecten subnodosus</i> (Sowerby, 1835)	scallop
Class: <u>Gastropoda</u>	
Family: <u>Turbinidae</u>	
<i>Turbo funiculosus</i> Kiener, 1847-48	turban
<u>Cerithiidae</u>	
<i>Cerithium</i> sp. Bruguiere, 1789	horn shell
<i>C. maculosum</i> Kiener, 1841	horn shell
<u>Strombidae</u>	
<i>Strombus galeatus</i> Swainson, 1823	helmet conch
<u>Calyptraeidae</u>	
<i>Crucibulum monticulus</i> Berry, 1969	shelf limpet
<u>Cypraeidae</u>	
<i>Cypraea albuginosa</i> Gray, 1825	cowry
<i>C. isabellamexicana</i> Stearns, 1893	cowry
<u>Cassididae</u>	
<i>Cassis coarctata</i> Sowerby, 1825	helmet shell
<i>Casmaria vibexmexicana</i> (Stearns, 1894)	helmet shell
<u>Cymatiidae</u>	
<i>Cymatium pileare</i> (Linnaeus, 1758)	hairy triton
<u>Muricidae</u>	
<i>Hexaplex erythostomus</i> (Swainson, 1831)	pink murex
<i>Muricanthus princeps</i> (Broderip, 1833)	murex
<u>Thaididae</u>	
<i>Thais</i> sp. Roding, 1798	Thais
<i>T. planospira</i> (Lamarch, 1822)	Thais
<i>Purpura pansa</i> Gould, 1853	Thais

Columbellidae		
<i>Columbella scorroensis</i>	Shasky, 1970	dove shell
Fasciolariidae		
<i>Fasciolaria princeps</i>	Sowerby, 1825	spindle conch
<i>Latirus socorroensis</i>	Hertlein & Strong, 1951b	spindle
Olividae		
<i>Oliva incrassata</i>	[Lightfoot, 1786]	olive
<i>O. porphyria</i>	(Linnaeus, 1758)	tent olive
<i>O. spicata</i>	(Roding, 1798)	olive
Mitridae		
<i>Mitra tristis</i>	Broderip, 1836	miter
Conidae		
<i>Conus diadema</i>	Sowerby, 1834	cone
<i>C. tiaratus</i>	Sowerby, 1833	cone
<i>C. purpurascens</i>	Sowerby, 1833	cone
<i>C. dalli</i>	Stearns, 1873	cone
<i>C. tessulatus</i>	Born, 1778	cone
<i>C. nux</i>	Broderip, 1833	cone
Terebridae		
<i>Terebra</i> sp.	Bruguiere, 1789	auger
<i>T. strigata</i>	Sowerby, 1825	auger
Siphonariidae		
<i>Siphonaria</i> sp.	Sowerby, 1824	limpet

2. Mollusca Species List by Area

Compiled by James Cordy, Lompoc, California

Southern Gulf of California (#) number of shells collected,
more than one specimen

		<u>comments</u>
La Paz Harbor April 6, 1974	<i>Pecten aequisulcatus</i> (3)	
	<i>Cerithium</i> sp.	sandy bottom
	<i>Oliva spicata</i>	
	<i>Hexaplex erythostomus</i>	
	<i>Terebra</i> sp.	
Isla Cerralvo April 7, 1974	<i>Lyropecten subnodosus</i>	few living shells,
	<i>Cypraea albuginosa</i>	many broken shells,
	<i>Strombus galeatus</i>	over a rocky-basalt
	<i>Fasciolaria princeps</i>	bottom
	<i>Conus diadema</i> (3)	

Cabo Pulmo Reef
April 12, 1974

Astropecten circularis
Lyropecten subnodosus
Pecten vogdesi
Strombus galeatus
Cassia coarctata
Muricanthus princeps
Olivia incrassata
O. porphyria
Fasciolaria princeps
Conus dalli
C. diadema
C. tessulatus (important find)

coral growths on
basaltic submarine
ridges

Revillagigedo Islands

*= endemic species

Isla San Benedicto
Punta Ortolan
April 9, 1974

Ostrea palmula
Casmaria vibexmexicana
Cypraea albuginosa
C. isabellamexicana (2)
Thais planospira
*Latirus socorroensis**
Conus diadema
C. tiaratus
C. dalli
C. nux
C. purpurascens (3)

large coral heads
on large basaltic
rocks, ridges

Isla Socorro
Grayson's Cove
April 10, 1974

*Turbo funiculosus**
*Columbella socorroensis**
*Latirus socorroensis**
Cypraea isabellamexicana (3)
Conus diadema
C. tiaratus
Siphonaria spp.

scattered coral
growths on large
basaltic boulders

Isla Socorro
Bahia Braithwaite
April 10, 1974

chiton
*Turbo funiculosus**
Cassia coarctata
Cymatium pileare (impt. find)
Purpura pausa
Corithium maculosum
*Columbella socorroensis**
*Latirus socorroensis**
Thais planospira
Mitra tristis
Terebra strigata
Conus diadema
C. purpurascens
Siphonaria spp.

scattered coral
growths on basaltic
boulders; sand sur-
faces in between
rocks

Pinnacle de Los Frailes

Cabo Pulmo Reef

April 12, 1974

Pecten subnodosus
P. vogdesi
P. circularis
Cassis coarctata
Strombus galeatus
Murex princeps (common)
Fasciolaria princeps
Conus diadema
C. dalli
C. tessulatus
Oliva purphyria
O. incrassata
Terebra sp.

A granitic rock
 rising 70 feet
 from a surrounding
 sandy surface

3. Distributions of Mollusca Extended by NAUI Expedition of April, 1974

<u>Scientific name (17)</u>	<u>new location</u>	<u>Previously listed distribution (after Keen, 1971)</u>
<i>Ostrea palmula</i>	Isla Socorro	Gulf of California to Ecuador
<i>Cerithium maculosum</i>	Socorro	Mazatlan to Tres Marias Is.
<i>Crucibulum moritculus</i>	Socorro	Mazatlan, G. of Cal, deep water
<i>Cypraea isabellamexicana</i>	San Benedicto	Guaymas to Panama
" "	Socorro	
<i>Cassis coarctata</i>	Socorro	G. of Cal to Ecuador
<i>Casmaria vibexmexicana</i>	San Benedicto	LaPaz to Tres Marias Is.
<i>Cymatium pileare</i>	Socorro	Isla Cedros-Panama, Hawaii
<i>Purpura pansa</i>	Socorro	G. of Cal - Galapagos
<i>Thais planospira</i>	San Benedicto	Cabo San Lucas - Peru
" "	Socorro	
<i>Mitra tristis</i>	Socorro	G. of Cal - Ecuador
<i>Conus diadema</i>	San Benedicto	common in G. of Cal to
" "	Socorro	Galapagos Is.
<i>C. tiaratus</i>	San Benedicto	G. of Cal to Ecuador
" "	Socorro	
<i>C. purpurascens</i>	San Benedicto	Magdalena Bay, G. of Cal
<i>C. tessulatus</i>	Cabo Pulmo Reef	rare cone off Pacific Coast, common Indo-Pacific species
<i>C. nux</i>	San Benedicto	Magdalena Bay, G. of Cal
<i>Terebra strigata</i>	Socorro	G. of Cal to Galapagos
<i>Siphonaria</i> sp.	San Benedicto	G. of California - off shore
" "	Socorro	islands

4. Molluscan Endemic Species confirmed on Revillagigedo Islands

<u>Scientific name</u>	<u>Area</u>
<i>Turbo funiculosus</i> Kiener, 1847-48	<u>Isla Socorro</u> , common at Grayson's Cove and Bahia Braithwaite, depth range 3 to 9 meters, on rocks
<i>Columbella socorroensis</i> Shasky, 1970	<u>Isla Socorro</u> , at Grayson's Cove and Bahia Braithwaite, in sand crevices, 6 to 12 meters depth
<i>Latirus socorroensis</i> Hertlein and Strong, 1951	<u>Isla Benedicto</u> , <u>Isla Socorro</u> , at Grayson's Cove and Bahia Braithwaite rocky surfaces 6 to 9 meters depth.

VI. SUMMARY

The April 1974 NAUI Bio-Marine Exploration Seminar to the Revillagigedo Islands revealed the following major observations:

1. The fish life at Isla San Benedicto and Isla Socorro is partially related to the Indo-Pacific species. The Hawaiian fish (Hobson, ~~B~~have, 1972) which were so obvious were *Zanclus canescens*, the Moorish Idol; *Forcipiger longirostris*, the Longnose Butterfly fish; and *Acanthus achilles*, the Surgeon fish. However, the fish life of these islands is definitely more strongly related to Panamic or the Eastern Pacific tropical water species (Hobson, 1968). Even *F. longirostris* was observed at the Los Frailes Pinnacle at the southern waters of Baja California. Perhaps the flow of the North Equatorial countercurrent, 5-10° N. latitude (National Geographic, 1965), is most responsible for bringing the Indo-Pacific fauna into these Eastern Pacific waters.
2. The Gastropod fauna was principally related to the Panamic tropical waters species of the Eastern Pacific. Approximately 17 species of molluscan shells have been extended to these Revillagigedo Islands, with the existing distribution range of shells taken from Keen, 1971. The only discovered shell which has a wide Indo-Pacific distribution (Keen, 1971) was the Hairy Triton, *Cymatium pileare*. Three endemic shells (Keen, 1971) of the islands were confirmed: *Turbo funiculosus*, *Columbella socorroensis* and *Latirus socorroensis*.

3. The large development of coral head formations at Isla San Benedicto, Punta Ortolan, was very spectacular. The volcanic rocks were densely covered by *Porites* sp. primarily. In comparison, at Isla Socorro, the older island, the coral growth was very sparse. Perhaps more diving time is needed at different locations throughout these islands to ascertain the extent and speciation of coral growths. By and large, I probably observed at least ten different species of coral although my species list simply classified most of them in the *Porites* sp., *Pocillopora* sp., *Pavona* sp. categories.
4. The Crown of Thorns, *Acanthaster planci*, was observed at all our diving stations where coral heads were found. The greatest density of *A. planci** was observed at Isla Cerralvo, Roca Montana, where we estimated approximately one specimen per ten square meters. At all locations, much dead coral was observed where *A. planci* lived. At this time I do not have any previous data to determine if this Asteroid is increasing or is presently normal for its population patterns. We did observe smaller *A. planci* at the Revillagigedos than in the Gulf of California waters.

There is a definite need for future expeditions to this area to specifically catalog and describe the coral species. Also, a systematic study of the *Acanthaster planci* situation is needed to determine if this starfish is a threat to these young coral heads.

* *A. ellisi* of the Gulf of California and *A. planci* may be the same species (Glynn, 1972)

One major handicap of our trip was the limited number of diving days available due to the long journey by boat to and from the Revillagigedos. I would recommend that future expeditions schedule at least 5-6 full days of diving at these remote islands.

Finally, the thrill of seeing these dormant volcanoes rising out of the sea and the magnificent marine fauna shall always be remembered. Certainly, as we review our color slides of the Clarion Angel fish, *Holocanthus clarionensis*, we can recall this golden beauty alongside all the other fish and invertebrate fauna. Moreover, for those who took land excursions to climb the volcanoes, they have additional memories of the pristine nature of these desolated islands. Yes, I and many others of our expedition would welcome the opportunity to return and visit these marvelous oceanic scenes.

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TO: THE GOVERNMENT OF MEXICO

Project Title: MARINE STUDIES IN THE GULF OF CALIFORNIA (MEXICO)

Date: January 21, 1974, Revised

Project Director: Dr. Gordon L. Chan
Director of Marine Technology
College of Marine
Kentfield, Ca. 94904
Telephone (415) 454-3962, Ext. 381

I. Introduction

Throughout many areas of North and Central America, the encroachment of man into the marine environment has been so significant that the landscape and biota have been heavily altered, and in some cases, permanently damaged. A major area with the marine environment still pristine is the southern reaches of the Gulf of California, ~~more commonly known as the Sea of Cortez.~~ *and surrounding marine biomes. The M*

This ecological-conservation-education proposal needs approval from the Mexican authorities.

The major objective of this project is to formulate base line data in these marine waters of Mexico.

II. Project Objectives

Before intelligent decisions can be made concerning the welfare of the marine resources of Mexico, baseline data must be available to assist these judgements. The goals of the project are:

2. To foster the conviction or attitude that there is much value in conserving these Mexican marine habitats in their ecological natural state.
3. To illustrate the ^{to marine biologists the} beauty of marine biological organisms and geological features which have remained unaltered over thousands of years.
1. To enable ^{eight} ~~these~~ marine ^{scientists and conservationists} ~~visitors~~ to ~~assist~~ in gathering base line data for education and use by the Mexican ^{and United States} ~~Government~~. Such information will be extremely valuable in detecting and evaluating changes in the marine environment in the event of man's technological advancements in the area.

- 2
4. To enable the ~~visitors~~ ^{marine participants} to educationally interact with United States and Mexican scientists in the study of the marine environment.
5. To provide to the participants an outdoor laboratory experience that is not available at the present time. Such experiences enable man to evaluate his role so that his actions can beneficially influence the world in which he lives.
6. To promote cultural understanding among all men.
- Cap

III. PROJECT RESEARCH ~~OPERATIONS~~ ^{TIME TABLE}

A. Revillagigedo Islands ^{Objective.} ~~the ones~~ Southwest of Cabo San Lucas, ~~the ones~~ as about 250 miles.

The major islands ~~to be~~ visited are :-

Isla San Benito, $19^{\circ}18'N$, $110^{\circ}49'W$

Isla Socorro, $18^{\circ}49'N$, $111^{\circ}00'W$

Previous expeditions to these islands have ~~reported~~ ^{reported} that these ~~marine~~ waters contain a mixture of ~~temperate~~ ^{temperate}, ~~sub-tropical~~ ^(California coast), and tropical ^(Hawaiian) marine organisms. Secondly, the coral reef biology of this area is poorly documented. The ~~major~~ ^{research} objectives of the project ~~are to be~~ ^{are} as follows:

1. ~~Record and photograph~~ the marine invertebrate and vertebrate species of these islands.
2. ~~Record, photograph and study~~ the coral reef ecology of these islands.
3. ~~Record and~~ ^{Establish} fixed submarine sampling stations ~~as~~ ^{and} ~~gather~~ ^{baseline data}, and ~~revisit~~ ^{revisit} these ~~island~~ ^{stations} at least once ~~per~~ ^{per} year to ~~record~~ ^{compare} the changes, if any.
4. To revisit the sampling stations recorded by the California Academy of Sciences Trip, January and November 1971, aboard the RV SEARCHER. (See enclosed maps).

Figure 1 and 2

In fact, the absence of major Coral reefs in the Eastern Pacific has always puzzled marine scientists. The Revillagigedo, on the same latitude as the Hawaiian Islands will provide Coral biologists an opportunity to examine the reasons why large coral reefs are ~~absent~~ ^{lacking} in the ~~area~~ ^{area}.

B. Timetable to the Revillagigedo Islands

1. Specific Date of first research expedition of this project:
April 6-13, 1974 (~~to be revisited March 29-29, 1975~~)

(1) Timetable

- April 6 - Leave La Paz, Baja California for Isla San Benedicto
- April 7-8 Establish underwater stations at Isla San Benedicto.
- April 9, 10 Establish underwater stations at Isla Socorro.
- April 11-12 ~~Return to~~ Evaluation - return to best site at this island.
- April 12, 13 Return to Cabo San Lucas and La Paz. Perhaps establish some stations at Cabo San Lucas area.

- B. Underwater stations will be marked on the maps as to latitude and longitude along with geological features. The ^{natural} degree of current, sea state and ^{degree of} turbidity will determine the feasibility of each scuba station.

- (2) Major Methodology of Sampling
- ~~Record all~~ ^{Record all} ~~data~~ ^{data} ~~will be made~~ ^{will be made}
1. Observations ^{and record} data by all diving participants. Species list will ^{be compiled} under the direction of marine scientists aboard. ^{The fish species list will have to be established on this expedition.}
 2. Establish ^{the coral and other marine invertebrate} density, population densities, using random sampling, ^{determine} mean, project statistical 95% confidence level for major organisms.

3. Photograph all major species and their particular ecological niche. Photographic slides will be made available to Mexican scientists for their records.

4. Record the major physical parameters of ^{surface or bottom} temperature ~~surface and bottom~~; salinities - ~~surface and bottom~~.

5. Take a plankton tow at every major sampling site, ^{in order} to record the ^{density of the} major trophic ~~levels~~ organisms of the food pyramid.

D. Other Gulf of California Marine Areas for Future Studies

The science methodologies of establishing baseline data and reviewing these stations by periodical visits may also include the following localities:

- ~~Isla Mujeres, Isla Cerralvo,~~
1. Cabo San Lucas, Los Frailes, Cabo Pulmo, all of the tip of the Baja Peninsula.
 2. Islands of: Isla Mujeres, Isla Cerralvo, Isla Espiritu Santo, Isla Partida, Mariska Seamount, Isla San Francisco, Isla San Jose, Isla Las Animas - all of the lower Gulf of California.

3. The timetable for these other areas is tentatively scheduled for ~~this trip, summer, next summer~~ 1974 and 1975. It is hoped that these other trips ~~listed under item D~~ will be approved in principle; and details will be forthcoming at a later date.

(you?)

Cap
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Project Sponsors

- A. The National Association of Underwater Instructors (NAUI)
22809 Benton Road
Grand Terrace (Colton), California 92324
Telephone: (714) 783-1862 Mr. Arthur Ulbrich, General Manager

This ~~association~~ non-profit association is the largest scuba diver certification agency in the world. ~~Its primary goal is to certify individuals, and underwater safety instruction and to encourage them to participate in~~ ^{its} primary goal is to insure ^{that} all divers have been safely trained; and to provide these divers an opportunity to explore the the mystery of the seas under scientific supervision. Therefore, this agency has developed a ~~Marine Bio-~~ Marine Exploration Seminar Program ^{where the divers show a} of which the Gulf of California is one area ^{that} has a strong preference for study.

- B. Dominican College of San Rafael, ~~Calif~~
San Rafael, California 94901
Telephone: (415) 453-9768 Sister M. Aquinas, O.P., Ph.D.
Biology Department

This college is a fully accredited institution of higher education, offering bachelor's and master's degrees in major educational disciplines. Participants desiring university credit may enroll in ~~the~~ Dominican College and sign-up for Biology 131: Natural History of the Revillagigedo Islands, 2 units.

- C. The financial ~~cost~~ ^{support} of the trip is ^a "pay-as-you-go" basis. The student-participants will have to bear the cost of the expeditions. (to be itemized later)

V. SCIENTIST and PARTICIPANTS

A. Scientists (8 Total)

1. Chief Scientist:

Gordon L. Chan, Ph.D.
Director of Marine Technology
College of Marin
Kentfield, California 94904
Vital endorsed.

2. First Scientist

Peter W. Glynn, Ph.D. (~~Stanford University~~)
Coral Biologist
Smithsonian Tropical Research Institute
P.O. Box 2072
Balboa, Canal Zone

Dr. Glynn is perhaps the foremost coral biologist on the Pacific Coast. He has written ²⁷ numerous papers on the ecology of coral reefs throughout the Caribbean and Panama Zone. He will be responsible for analyzing and listing the taxonomy of the ^{unknown} corals of the Revillagigedo Islands.

3. Second Scientist

Edmund Hobson, Ph.D.
Fishery Biologist
P.O. Box 398
Avalon, California 90704

Dr. Hobson, in the opinion of many, is the authority on tropical reef fishes of the Eastern Pacific. His papers on the schooling and behavior of tropical fishes in the

laboratory of California and Hawaii have been established as the foundation of fish behavior. He is also one of the leading authorities on the grey sharks which is common at the Revillagigedo. He will direct the studies of the fishes observed at these islands.

4. ~~Chief~~ Mexican Scientist

Roberto Calderon-Campos
Marine Biologist
Universidad Autonoma de Baja California
Unidad de Ciencias Marinas
Apartado Postal 453
Ensenada, B. C.F.A., Mexico.

Mr. Calderon-Campos is highly recommended (letter enclosed) as a marine biologist and accomplished diver with three underwater certifications. He will assist all divers in organizing the taxonomy of marine invertebrates, particularly the mollusca and Arthropoda phyla.

5. Mexican Scientist

Alfonso Molina, M.A.
Director, ~~Station~~
Bolin's Marine Station
Bolin's, California 94927

Mr. Molina is a botanist, specializing in temperate and sub-tropical flora, and is ^{also} an excellent marine ecologist.

over →

6. Other Scientists

Dr. T. Birkeland
Marine Ecologist
Smithsonian Tropical Research Institute
P.O. Box 2072
Balboa, Canal Zone

Will assist in coral biology and is an expert in the submarine geology of the Eastern Pacific.

James Condy
~~816~~ NASA Malacologist
316 So. Seventh St.
Longport, Ca. 93436

Dr. Eugene S. Winter
Malacologist
Walla Walla College
College Place, Wash. 99324

Both of the above individuals will direct the taxonomy of gastropods located in the Revillagigedo.

B. Participants

The purpose of this proposal is to open ~~such~~ marine experiences to all who desire this educational ~~adventure~~ in the Sea of Cortez. The ~~speculative~~ list of participants ~~from both the United and Mexico~~ might include:

1. Students and teachers with interest in marine science. High school and college classes, in particular, would be an important part of the potential participants.
2. General public, ^{minimum age 16} with no age limitations.
3. All divers must hold a national diving certification, such as NAUI.
4. There will be room for 30 ~~to~~ 33 ~~of~~ those student-participants.
5. The total cost for each participant to the Revillagigedo from San Diego, California will be \$440.00, including airfare (Aeromexico airline).

VI. VESSEL

The vessel to be used, April 6-13, 1974, is the SALTY DOG (also referred to as FINALISTA)

American registration No. 527160

Captain: Mr. Robert Strange

Owner: Mr. Ken Golden

H+M Landing
3001 ~~and~~ Emerson Street
San Diego, California 92106

This vessel was chosen because of its classroom-lecture-diving capabilities. This vessel is 100 feet, ~~fully~~ ³ screws powered by 3 Caterpillar engines, cruises at 13 knots, fuel capacity of 3300 gallons, range 850 miles. Fully air-conditioned, separate washrooms, showers, 15 carpeted staterooms. Dual compressor scuba system, equipped about 12

with 40 tanks, harness, and weight belts for divers
The large galley can be used as a classroom for
lectures and audio-visual review of marine species. There
~~is also ample deck~~ deck space for handling and reviewing
~~We~~ also two large specimens?
As a double Avon boats will be available for diver's

also two of specimens? Avon
Small rubber ~~hull~~ boats will be available for diver's support.
We have plans to use ~~this vessel~~ in the
~~is also on our plans to be used~~ in the

support. ~~We have plan to use this vessel~~
~~This vessel is also on our plans to be used~~ in the
 continuing research programs to visit the other ^{spring and} ~~and~~ of California
 Islands during the summer of 1974 and 1975. ~~This vessel~~
~~is employed as the vessel to return to each of our~~ ~~plans~~

VII EXPENDITURES

A. Basic Cost

A. Basic Cost
Student participants will be expected to pay \$440 as full fees. Air carrier will be Aeromexico of Mexico.

B. Other Costs

- B. Other Costs
1. Buy fuel and supplies in La Paz for the Ship
 2. ~~Hotel costs in La Paz~~
 3. ~~Food costs in La Paz~~
 2. Other Costs in La Paz : Hotels, food, supplies, Buses, taxis.

SUMMARY STATEMENT

SUMMARY STATEMENT

The major goal of the project is to develop base-line data for the Revillagigedo Islands. This project ^{request} that the April 6-13, 1974 trip be approved and the return trip in ~~the~~ March 22-29, 1975. Also, ² approval in principal, ^{to achieve the goal:} ^{also needed for} secondary trips in the lower Gulf of California during the summers of 1974 and 1975. Thank you very much for your ^{immediate attention &} kind consideration.

Robert Chinn

VIII Project Advisors

Dr. Amin Zarrar Menez
Officer in Charge
Mexican Government Fish Commission
233 A Street, Suite 1104
San Diego, Ca. 92101

Mr. Susumu Kato
Fishery Biologist
National Oceanic
Tuberos Marine Fisheries

Mr. William G. Gordon
Dean of Program Operations
California Community Colleges
825 15th Street
Sacramento, Calif. 95814

Dr. John E. McCosker
Superintendent
Steinhart Aquarium
California Academy of Sciences
1913 Loma La Plazuela